

CAS No: 7664-41-7

Synonyms: Anhydrous ammonia, ammonia gas, AM-Fol, Nitro-sil, R 717, spirit of hartshorn, UN1005 (DOT)

Molecular Formula: NH_3

Molecular Weight: 17.03

Degradation or Byproducts: When ammonia enters a water system, it can raise the pH of the water because of the production of hydroxide ions. Ammonia is degraded by nitrification to form nitrates under aerobic conditions. Nitrification occurs in two stages: ammonia is first converted to nitrite by the bacteria genus *Nitrobacter* and then to nitrate by the genus *Nitrosomonas*. Ammonia reacts violently and/or forms explosive products with halogens, interhalogens, and oxidizers.

Environmental Fate and Transport:

Air: Ammonia is a gas in the atmosphere and may combine with sulfate ions. The half-life in the atmosphere is only a few days.

Water: Ammonia has a water solubility of 89.9 g per 100 mL of water. Aqueous solutions with ammonia concentrations of 1.0, 0.1, and 0.01 N have a pH of 11.6, 11.0, and 10.6, respectively. The concentration of ammonia in a 1.0 N solution is 17.03 g/L. Volatilization can occur from water.

Soil: Atmospheric ammonia is returned to the soil by washout through rain fall. The chemical is strongly adsorbed to soil and sediments in the presence of oxygen but is less adsorbed under anoxic conditions, where it is released to the water column or oxidizing sediments. Ammonia is lost from soil by volatilization; it is taken up from the soil by plants.

Mechanism of Toxicity: Ammonia is a caustic agent capable of causing irritation and chemical burns in the gastrointestinal and respiratory tracts, as well as the skin and eyes. Ammonia is converted to ammonium hydroxide, whose highly alkaline properties cause saponification of membrane fats in the epidermis. This destroys the impermeable barrier to hydrophilic substances, resulting in deeper penetration of the ammonia in the skin and mucus membranes. In addition, the high alkalinity causes denaturation of tissue proteins. Elevated blood ammonia levels can lead to brain edema.

Exposure Routes: Oral, Inhalation, Dermal

Symptoms: Acute ingestion of ammonia solutions may cause injury and burns in the mouth, pharynx, and esophagus. Humans exposed to high concentrations of ammonia vapor experience respiratory distress with pain in the pharynx and chest, cough, and dyspnea. Death from inhaled ammonia is from pulmonary edema. At lower concentrations, irritation to the eyes, upper respiratory tract, and throat are reported. Laboratory animals fed diets containing high levels of ammonia had changes in brain enzyme activities.

Target Organs: The eyes, respiratory and gastrointestinal tracts, and skin are sensitive to contact with ammonia; the brain is affected by elevated blood ammonia levels.

TABLE 1. PAL Inhalation Exposure Guidelines for Ammonia (ppm [mg/m³])

Guideline	Exposure Duration			
	24-h	30-d	90-d	2-yr
PAL 1	25 [17]	19 [13]	19 [13]	9.2 [6.4]
PAL 2	110 [77]	61 [43]	61 [43]	26 [18]
PAL 3	220 [154]	130 [87]	130 [87]	NR

NR = Not recommended because of insufficient data.

TABLE 2. PAL Oral Exposure Guidelines for Ammonia (mg/L)

Guideline	Exposure Duration			
	24-h	30-d	90-d	2-yr
PAL 1	600	600	600	220
PAL 2	NR	NR	NR	NR
PAL 3	NR	NR	NR	NR

NR = Not recommended because of insufficient data.

TABLE 3. Other Inhalation Standards and Guidelines for Ammonia (ppm)

	10 min	30 min	60 min	4 hr	8 hr
AEGL^a					
AEGL 1	30	30	60	30	30
AEGL 2	220	220	160	110	110
AEGL 3	2700	1600	1100	550	390
ERPG-1^b	25 ppm (1-hour)				
ERPG-2^b	150 ppm (1-hour)				
ERPG-3^b	750 ppm (1-hour)				
EEGL^c	100 ppm (1-hour); 50 ppm (24-hour)				
CEGL^d	10 ppm (90-day)				
NIOSH IDLH^e	300 ppm (30 minutes)				
NIOSH REL^f	25 ppm (8-hour TWA)				
NIOSH STEL^g	35 ppm (15 minutes)				
OSHA PEL-TWA^h	50 ppm (8-hour TWA)				
ACGIH TLV-STELⁱ	35 ppm (15 minutes)				
ACGIH TLV-TWA^j	25 ppm (8-hour TWA)				
SMAC^k	20 ppm (1-hour); 14 ppm (24-hour)				

^aAEGL (Acute Exposure Guideline Levels) (NRC 2001)

^bERPG (Emergency Response Planning Guidelines) (AIHA, 2008)

^cEEGL (Emergency Exposure Guideline Level) (NRC, 2007)

^dCEGL (Continuous Exposure Guidance Level) (NRC, 2007)

^eNIOSH, IDLH (National Institute of Occupational Safety and Health, Immediately Dangerous to Life and Health) (NIOSH, 1994)

^fNIOSH REL (National Institute of Occupational Safety and Health, Recommended Exposure Limits) (NIOSH, 2005)

^gNIOSH STEL (National Institute of Occupational Safety and Health, Short-term Exposure Limit) (NIOSH, 2005)

^hOSHA PEL-TWA (Occupational Safety and Health Administration, Permissible Exposure Limits – Time Weighted Average) (OSHA, 2005)

ⁱACGIH TLV-STEL (American Conference of Governmental Industrial Hygienists, Threshold Limit Value – Short-Term Exposure Limit) (ACGIH 2009)

^jACGIH TLV-TWA (American Conference of Governmental Industrial Hygienists, Threshold Limit Value – Time Weighted Average) (ACGIH 2009)

^kSMAC (Spacecraft Maximum Allowable Concentrations) (NRC, 2000)

TABLE 4. Other Oral Standards and Guidelines for Ammonia

None available